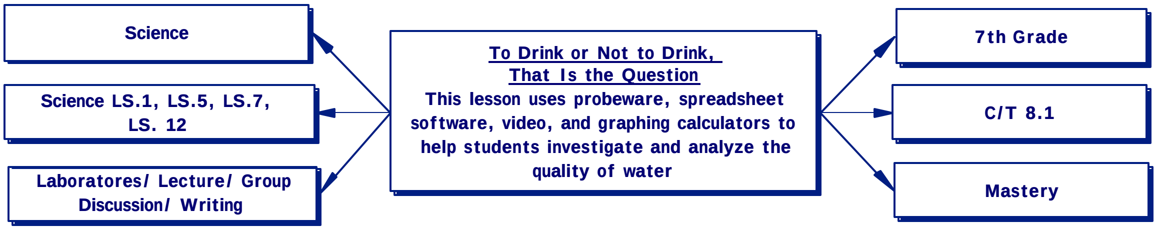

To Drink Or Not To Drink, That Is The Question or Water, Water Everywhere, And Not A Drop To Drink

Cindy Cox
Winchester Public Schools

Curriculum Area	Science
Subject Area	Life Science
Grade Level	7th grade
Learning Objectives	• The student will be able to analyze the statement that water equals life. • The student will be able to define water quality, pH, dissolved oxygen, macroinvertebrates, instream use, offstream use, turbidity, salinity and stream monitoring. • The student will be able to use science probeware to test for pH, temperature, and dissolved oxygen to indicate water quality • The student will be able to use a biological key to check for various groups and population numbers of the macroinvertebrates to determine water quality.
Correlation to the SOL	LS.1, LS.5, LS.7, LS.12 C/T 8.1
Video/Technology Hardware/Software Needed	**For class:** TV Monitor/VCR Multimedia Computer Computer Projection System Spreadsheet software (such as *Microsoft Excel* or *ClarisWorks*) 3 computers with probeware and TI 83 Graphing Calculators attached (see specific instructions for each station, attached: station 1, station 2, station 3, station 4 (see also instructions for loading probes) MECC's *Clean Water Detective* **For each student:** Computer attached to a printer Word Processing software (such as *Microsoft Word* or *ClarisWorks*)

	Video: *Shamu TV #18 Discovering Animal Training and Other Careers in Marine Biology, Part II* *Environmental Change* *Bill Nye, The Science Guy, #209 Rivers and Streams*
Materials Required	**For class:** See specific instructions for each station. Each station includes a list of materials and a three-fold printout of instructions/information that can glued to a three-fold piece of cardboard and set by each station. **For each student:** Clean Water Detective Worksheet Evaluation Rubric **For teacher demonstration:** 1 dropper 2 1000 ml graduated cylinders 2 100 ml graduated cylinders 2 small two inch square sheets of wax paper 1 plastic two liter jug of colored water
Procedures/Activities	1. Ask the students what they know about water quality in general. Display their comments in a web on a large sheet of poster board. Ideas are recorded under the main headings of ABLGUF (**A**ppearance, **B**ehavior, **L**ocation, **G**roup, **U**sage, and **F**unction) in order to organize and arrange concepts to find a complete description of water quality. The goal of this activity is for students to generate ideas and not to debate or discuss them. Post this mind map in the classroom to serve as a reference. 2. Water resources are used throughout our society. The same water can be utilized many times. Water is available from surface sources such as rivers, ponds, lakes, and from ground water sources called aquifers. Instream use is defined as water that does not require removing water from a river, stream or surface water source. Recreation, powerplants, and transportation generally consume very little water. Offstream use is where the water is removed from a ground or surface source reducing the amount available for other uses. 3. Do a Think-Pair-Share activity by having the students list all the possible ways water is used. After three minutes, have them share their list with a partner and add any ways they did not have to their list. Compile a class list of ways water is used by going around the room and asking a spokesman from each group to name one of the possible uses of water from their combined list. Have the rest of the class check the use off of their paper as it is mentioned. 4. Water is found in our atmosphere, in our soil, and underneath our ground. Even the human body is about 75% water. The total amount of water on earth stays the same, and the same water that exists now has always existed. Because water covers 75% of the earth, it is very easy to think of water as an unlimited resource. Most of our water is found in the oceans and seas as salt water. It is estimated that 97% of the water on earth is salt water with only 3% fresh water. The majority of the fresh water is polar icecaps, remote glaciers, and icebergs. Accessible fresh water comes from both surface and groundwater, which is less than one-half of one percent of all the water on earth. The average American uses about 150 gallons or 570 liters of this fresh water supply per day. 5. As a teacher demonstration, set up a model of the distribution of the earth's water and compare the relative volumes and percentages of the various types of water on earth. Fill a one-liter plastic jug or soft drink container with colored water. Pour the colored water into a 1000 ml graduated cylinder. Tell the students that this represents the earth's entire supply of water. Next, pour

28 ml out of the large graduated cylinder into a second 1,000 ml graduated cylinder. The 28 ml of water represents our total supply of fresh water on this planet. The remaining 972 ml in the first graduated cylinder represents the amount of salt water in our oceans. From the 28 ml graduated cylinder pour out 23 ml into the 100 ml graduated cylinder to represent the fresh water in our icecaps and glaciers. From the 28 ml graduated cylinder, pour out 4 ml into another 100 ml graduated cylinder to represent groundwater. With the dropper take out 2 drops and put it on a piece of wax paper to represent water in rivers, ponds, lakes, and streams. From the 28 ml container take out one drop and put it on the wax paper. This is the amount of water in the atmosphere and soil.

6. As a whole class activity, develop a spreadsheet using the proportions from the water supply experiment and then graph the percentages of water in the oceans, ice caps, groundwater, surface water, and water in the atmosphere and soil.
7. As with the human body, not all sources of water are equally healthy all of the time. Just as getting a physical check-up on a regular basis is important to us, checking the river, stream, lake, or pond at regular intervals can provide us with the information we need to maintain or improve its water quality.
8. Explain to the students that they are going to watch a brief video segment on water quality. This video segment focuses on a career in water quality. You will meet Michael Tucker who is responsible for water quality for the animals at Sea World. See if you can determine some of the duties that Michael does on a typical day. **Fast Forward** *Shamu TV #18* about 5 minutes from the beginning to where you hear the boy say, "Can you imagine all the animals at Sea World that also need clean water?" Start the segment after that comment. **Play. Stop** when you hear the girl say, "See you next time." Discuss Michael Tucker's responsibilities and how he keeps the animals' homes clean.
9. Water chemistry is a fascinating and complex topic because water has several unusual properties. The density of water as ice is lower than the density of water as a liquid, which means that ice floats. The union of two hydrogen atoms and one oxygen atom forms water. The oxygen atom is bonded to the hydrogen atoms in an asymmetrical pattern. This causes water to become a solvent for many types of materials. As water moves through the hydrologic cycle there are many ways it can pick up pollutants. In the atmosphere, water vapor may form around particulate matter from factory smokestacks, car exhausts, smoke, and other sources. The water then may fall to earth through precipitation and cause pollution of surface waters. Running over the land, water picks up pollutants from farms, streets, and lawns. As water moves through the ground it may come in contact with pollutants that have leaked from landfills.
10. Water quality can be determined chemically or biologically. Watch this same video segment again for the types of tests made on the water to keep it safe for the animals. **Rewind and Play Again. Remove tape.** Ask the students to list the tests done. Temperature, pH, turbidity, and salinity were done with the use of technology. Professionals use computers, monitors, and probes. We can do these same tests in the classroom or in local streams and rivers to test the quality of the water. The results from these tests can give us valuable information as to how safe the water is.
11. The water temperature of a river is very important for water quality. Temperature influences the amount of oxygen that can be dissolved in water, and the metabolic rates of aquatic animals. Cool water can hold more oxygen than warm water, because gases are more easily dissolved in cool water. Water has a high heat capacity, which makes it resistant to changes in temperature. Why would high temperatures in water have to be monitored? In winter, water temperatures are often warmer than air temperatures. Increased

	temperatures can decrease water's ability to hold dissolved oxygen and can impair feeding, growth, reproduction of fish. 12. pH is a common indicator of water quality. It is a measure of what degree water can be acid or base. The pH scale ranges from 0 to 14 (0 is most acidic, 7 is neutral, and 14 is most basic). In the next video clip, students have asked a scientist to test the pH of a water sample. Watch this segment and explain how the scientist tested the pH level of the water. **Fast Forward** *Environmental Change* about 16 minutes from the beginning until you hear the scientist say, "If you think the problem is due to atmospheric conditions, then let's test your theory" **Play. Stop** when you hear the other scientist say, "It's really nasty stuff" What tool was used to test for pH? How was the water prepared for testing? **Rewind. Play again with sound off.** Discuss the steps in using a pH meter to measure pH. It is important to remember that for every unit change on the pH scale, there is approximately a ten-fold change in how acidic or basic the sample is. Rainwater is naturally somewhat acidic with a pH of about 6.5. pH affects the respiration rates of fish as well as solubility of many chemicals and metals. Most fish species have a pH tolerance that ranges from a 6 to 8.5. **Remove tape.** 13. Water is a very unique substance in that you can dissolve gases in it. Oxygen is one such gas. Much of the dissolved oxygen in water comes from the atmosphere. Waves on lakes, slow moving rivers, and tumbling water act to mix oxygen with water. Algae and rooted aquatic plants also deliver oxygen to water through photosynthesis. Ask the students to list the different ways oxygen is being added to the river in this next segment. **Fast Forward** *Bill Nye the Science Guy #209 Rivers and Streams*, about 5 minutes from the beginning until you hear Bill Nye say, "The fresh water mixes with the salt water. There are whole ecosystems that depend on this mixing. It's a process that has gone on for millions of years." **Play with sound off. Stop** when you see Bill Nye in a kayak. Dissolved oxygen, a measure of the concentration of oxygen in water, is essential for the maintenance of healthy lakes and rivers. The presence of oxygen in water is a positive sign; the absence of oxygen is a signal of severe pollution. Waters of consistently high, dissolved oxygen are considered healthy. A healthy warm water stream may have oxygen levels of 11 mg/L (1 ppm = 1 mg/L) or higher. 14. Divide the class into three groups. These three teams will rotate every twenty minutes through three teacher-prepared stations to learn how to use the temperature probe, the pH probe, and the dissolved oxygen probe. The teacher-prepared stations will contain directions for use of the CBLs and probeware, a brief description of the item being tested, and the experiments that are to be done at the station (see attached). To save time have the probes already in Channel One. The oxygen probe needs extra time and must be set up prior to this lesson by the teacher. 15. Use the MECC Computer Program entitled, *Clean Water Detective.* It is an excellent program to use as an introduction to what scientists do in the real world to determine the cause of pollution at a certain site. Students are given a case to investigate various types of pollution using various tests such as: COLOR: clues about where the water flows from and how it is used SAMPLE: information on bacteria, pH levels, pollutants, and oxygen present in the water OBSERVE: see types of shoreline and animal community present WATER TEMPERATURE: gives you the temperature of the water ODOR: tells where the water flows from and what might be wrong CLEARNESS: how far down you can see into the water. They begin as an "assistant" to find out who polluted the river. The next level is termed "detective" where the task is to determine who did it and to identify the cause. The last level is "enforcer" where students are asked to once again

	find out who did it, the cause, and then to suggest an action taken for the culprit. Use the attached Clean Water Detective Worksheet. 16. Each student should write a report about their findings. Give the students the evaluation rubric to guide them as they create their report.
Content Assessment	1. Assess student performance during the labs and evaluate answers from the lab report. 2. Give a quiz on the objectives for the lesson. 3. Group interaction and group experimentation can be assessed.
Technology Integration Assessment	See attached rubric
Extensions	**Science:** Research the various types of wetlands such as bogs, swamps, marshes, and coastal marine wetlands. **Technology:** Post a message on the electronic bulletin board asking for classes located along rivers or streams to share information with your class. **Careers**: Invite a hydrologist into the classroom to share some helpful tips to determine water quality. **Current Events:** Watch for water issues in the local paper. Cut them out and discuss your findings in class. **English:** Brainstorm water words, make word trees with those words and finally write poetic statements about water using a word search or Crossword Companion program. **English:** Have students investigate, write, and produce a newspaper that features aquatic information and issues. Use *AppleWorks* or any word-processing program to create a pamphlet. **Art:** Have students bring in photographs from magazines that show water. Ask them to look especially for pictures that show how living things depend upon water. Have students create a collage of the photos. **Music:** Sing the song, H_2O from the Chemical Songbook by Michael Offut, J. Weston Walch Publisher. **History:** Trace the historical development of the area around the stream and how the uses of the stream have impacted its health. Present this in a Power Point presentation scanning photographs and including graphs of current water use and stream health.

Temperature probeware station
For each of the four groups that rotate through this station:
1 1000 mL beaker
1 50 mL beaker
5 tablespoons
1 lb. box of salt
1 gallon of water
1 container of 7 ice cubes
1 large bucket in which to dump water after each group finishes

TEMPERATURE

PANEL ONE

THE FAHRENHEIT AND CELSIUS SCALES

FAHRENHEIT Water Boils at 212^{o} Water Freezes at 32^{o}		CELSIUS OR CENTIGRADE Water Boils at 100^{o} Water Freezes at 0^{o}
120		**49**
110		**44**
100	**VERY HOT**	**38**
90		**32**
80		**26**
70	**Much Plant Life, many fish**	**21**
60		**16**
	Trout, caddisfly, stonefly	
50		**10**
40		**5**
30	**FREEZING**	**0**

Most aquatic organisms have adapted to survive within a range of temperatures (68 degrees to 55 degrees F or 20 degrees to 13 degrees C)

Formula for converting Fahrenheit to Celsius: $F = 9/5\ C + 32$

Formula for converting Celsius to Fahrenheit: $C = 5/9\ (F - 32)$

TEMPERATURE

PANEL TWO

HOW TO OPERATE THE TEMPERATURE PROBE WITH THE CBL.

Make sure the cables between the CBL and calculator are pushed in firmly.

On the calculator:

*Press "**PRGM**" button for program selection.
*At "EXEC EDIT NEW" select < **1: Physics>** then press **ENTER**
*At **"**prgm PHYSICS**"** press **ENTER**
*****At "VERNIER SOFTWARE" press **ENTER**
*"Main Menu": select **<1: Set up Probes** > then press **ENTER**
*At Number of Probes: select **<1:one>** then press **ENTER**
*At Select Probe: select <**6: Temperature**> then press **ENTER**
*At Plug This Probe Into Channel 1: plug **in the sensor** then press **ENTER**
*Calibration: select **<1: Use Stored>** then press **ENTER**
*Main Menu: select **<2: Collect Data** > then press **ENTER**
*At Data Collection: select **<2: Time Graph>** then press **ENTER**
*At Enter Time Between Sample in Seconds: <**1.0**> then press **ENTER**
*At Enter Number of Samples: **<20.0>** then press **ENTER**
*Next screen: press **ENTER**
*Continue: select <**1: Time Setup**> then press **ENTER**
*At Time Graph: select **<2: Live Display**> then press **ENTER**

*At Set Y- axis:
Y min = **<0>** then press **ENTER**
Y max = **<50>** then press **ENTER**
Yscl = **<5>** then press **ENTER**
*Press ENTER to Begin Collecting Data: press **ENTER**
*When the CBL system indicates "**DONE**" press **ENTER**
Line graph will be displayed on the screen.
*To **Repeat** the experiment: select **<2 YES>** then press **ENTER**
*Repeat everything by going back to *At Set Y-axis for each time you measure temperature.

TEMPERATURE

PANEL THREE

EXPERIMENTS TO DO!

1. Take the probe in your hand and press enter on the screen to begin graphing. Hold the temperature sensor between the palms of your hands. Rub your hands back and forth quickly. Try to sustain a temperature increase. Is it possible?

2. Put 700 mL of water and seven ice cubes in a 1000 mL beaker. Press enter and graph what you find as you put the probe in the bottom of the beaker on the bottom.

3. Press Yes for repeat. Next, move the probe to the top of the beaker near the surface where the ice is floating. Leave the probe there. What happened to the graph? What does this tell you about the temperature in the beaker?

4. Fill another beaker with 50 mL of water. Measure the temperature of the water. Press enter and graph the temperature. Next add 2 tablespoons of salt in the beaker with the temperature probe.

5. Press Yes for repeat. Gently move the probe around as the salt dissolves. What happens to the graph?

6. Record a question that your group asked and wants answered or an experiment you would like to try later using the temperature probe.

7. Before leaving this station, pour both beakers of ice and water into the bucket.

pH probeware station
For each of the four groups that rotate through this station:
1 1000 mL beaker
1 50 mL beaker
1 250 mL beaker
1 graduated cylinder
1 gallon of distilled water
2 small boxes of baking soda
5 tablespoons
1 large bucket in which to dump water after each group finishes

pH

PANEL ONE

The acidity of a solution can be expressed using the pH scale. The pH of a solution shows its acidity in terms of the number of atoms in concentration. The pH scale ranges from 0 to 14. Solutions above 7 are basic. Solutions below 7 are acidic. A neutral solution has a pH of 7. A neutral solution is neither an acid nor a base. Pure water is neutral and has a pH of 7. The average pH of rainfall over much of the United States is 5.0-5.6. The pH of natural water is usually between 6.5 and 8.5.

Concentrated solutions of strong acids have a pH near 0. Concentrated solutions of weak acids can have a pH range of 2 to 5. A concentrated solution of a strong base has a pH near 14. Concentrated solutions of weak bases can have a pH range of 9 to 12.

APPROXIMATE pH VALUES OF SOME COMMON SUBSTANCES

ITEM	pH
battery acid	1
stomach contents	1.6
vinegar	2.8
apple	3
coke	4
milk	6.5
distilled water	7
blood	7.3
sea water	8.4
ammonia	11
bleach	12

PANEL TWO pH

HOW TO OPERATE THE pH PROBE USING THE CBL

The CBL has been programmed to use the pH probe already. Repeat should be on the screen.
Select <2 Yes> then press ENTER.

*Press "**PRGM**" button on TI for program selection.
*At "EXEC EDIT NEW" select < **1: Physics>** then press **ENTER**
*At **"**prgm PHYSICS**"** press **ENTER**
*****At "VERNIER SOFTWARE" press **ENTER**
*"Main Menu": select **<1: Set up Probes** > then press **ENTER**
*At Number of Probes: select **<1:one>** then press **ENTER**
*At Select Probe: select < **pH** > then press **ENTER**
*At Plug This Probe Into Channel 1: plug **in the sensor** then press **ENTER**
*Calibration: select **<1: Use Stored>** then press **ENTER**
*Main Menu: select **<2: Collect Data** > then press **ENTER**
*At Data Collection: select **<2: Time Graph>** then press **ENTER**
*At Enter Time Between Sample in Seconds: <**1.0**> then press **ENTER**
*At Enter Number of Samples: **<20.0>** then press **ENTER**
*Next screen: press **ENTER**
*Continue: select <**1: Time Setup**> then press **ENTER**
*At Time Graph: select **<2: Live Display**> then press **ENTER**
*At Set Y- axis:

Y min = **<0>** then press **ENTER**
Y max = **<50>** then press **ENTER**
Yscl = **<5>** then press **ENTER**
*Press ENTER to Begin Collecting Data: press **ENTER**
*When the CBL system indicates "**DONE**" press **ENTER**
Line graph will be displayed
*To **Repeat** the experiment: select **<2 YES>** then press **ENTER**
*Repeat everything by going back to *At Set Y-axis for each time you measure temperature.

* Place the pH probe in a beaker of distilled water when not being used.

* Change the distilled water for the probe when you are ready to go to the next group.

* Place the pH probe in the various substances at this station. Read the pH level on the top of the screen.

* After you have read the pH of a substance, put the probe back in the distilled water before using it in another substance.

* Before leaving, change the distilled water the probe is in and dump the vinegar soda solution in the wastewater container.

pH

PANEL THREE

EXPERIMENTS TO DO!

1. Take the pH probe out of the distilled water and place it in the box of baking soda. Does the probe measure the pH of a dry substance?

2. Take the pH probe out of the distilled water and place it in a clean 1000 mL beaker with 50 mL of vinegar. What is the pH reading?

3. Leave the pH probe in the beaker of vinegar. Add one tablespoon of baking soda to the vinegar. Watch the pH reading on the Newton screen. What happens?

4. Predict what would happen if another tablespoon of baking soda was added. Now add another tablespoon of baking soda. Watch the pH reading. What happened?

5. Take the pH probe out of the distilled water and place it in the beaker of 50 ml of water. Add a little shampoo and stir it up with a stirring rod. Read the pH of the shampoo. Is it important for a shampoo to be pH balanced? Should face cream and deodorant have a certain pH?

Dissolved Oxygen probe station
For each of the four groups that rotate through this station:
1 gallon of distilled water
1 gallon of tap water
1 1000 mL beaker
4 250 mL beakers
1 graduated cylinder
1 container of 7 ice cubes
heat source to heat water
1 egg beater
1 large bucket to dump wastewater after each group finishes

DISSOLVED OXYGEN

PANEL ONE

Oxygen is the most abundant element on earth. About 50% of the earth's crust of rocks and sand is made up of oxygen. Your body contains 65% oxygen, water contains 89%, and common mineral substances such as sandstone and limestone, nearly 50% oxygen. Oxygen is one of the most active elements. It combines readily with other elements.

Most aquatic plants and animals need oxygen to survive. Fish and some aquatic insects have gills to extract life-giving oxygen from the water. Dissolved oxygen is the amount of oxygen that is located between the water molecules. It is not part of the molecule of hydrogen and oxygen that makes up water.

A basic parameter that indicates if a body of water is healthy is dissolved oxygen. The dissolved oxygen or "DO" is influenced by several factors, including water temperature, salinity, atmospheric pressure or altitude, and the amount of oxygen demanding wastes such as manure, leaf litter, woody debris or organic materials that are in the water. Dissolved Oxygen is expressed as milligrams per liter or mg/L. At the relatively cool temperature of 15 degrees C, one would expect a river to have a dissolved oxygen value higher than 80 %. (4.69 mg/L)

Much of the dissolved oxygen in water comes from the atmosphere. Waves on lakes and slow-moving rivers, and tumbling water on fast-moving rivers act to mix atmospheric oxygen with water. Algae and rooted aquatic plants also deliver oxygen to water through photosynthesis. Dissolved oxygen levels rise from morning through the afternoon as a result of photosynthesis, reaching a peak in late afternoon.

Gases, like oxygen, dissolve more easily in cooler water than in warmer water.

DISSOLVED OXYGEN OR (DO)

PANEL TWO

HOW TO OPERATE THE DISSOLVED OXYGEN PROBE USING THE PROBE WITH THE CBL.

Always return the dissolved oxygen probe to a 250 mL beaker of distilled water.
Make sure the cables between the CBL and calculator are pushed in firmly. PRESS YES for repeat and begin at the Y

On the calculator:
*Press “**PRGM**” button for program selection.
*At “EXEC EDIT NEW” select < **1: Physics>** then press **ENTER**
*At **“**prgm PHYSICS**”** press **ENTER**
*****At “VERNIER SOFTWARE” press **ENTER**
*”Main Menu”: select **<1: Set up Probes** > then press **ENTER**
*At Number of Probes: select **<1:one>** then press **ENTER**
*At Select Probe: select <**6: Temperature**> then press **ENTER**
*At Plug This Probe Into Channel 1: plug **in the sensor** then press **ENTER**
*Calibration: select **<1: Use Stored>** then press **ENTER**
*Main Menu: select **<2: Collect Data** > then press **ENTER**
*At Data Collection: select **<2: Time Graph>** then press **ENTER**
*At Enter Time Between Sample in Seconds: <**1.0**> then press **ENTER**
*At Enter Number of Samples: **<20.0>** then press **ENTER**
*Next screen: press **ENTER**
*Continue: select <**1: Time Setup**> then press **ENTER**
*At Time Graph: select **<2: Live Display**> then press **ENTER**

*At Set Y- axis:
Y min = **<0>** then press **ENTER**
Y max = **<50>** then press **ENTER**
Yscl = **<5>** then press **ENTER**
*Press ENTER to Begin Collecting Data: press **ENTER**
*When the CBL system indicates “**DONE**” press **ENTER**
Line graph will be displayed on the screen.
*To **Repeat** the experiment: select **<2 YES>** then press **ENTER**
*Repeat everything by going back to *At Set Y-axis for each time you measure temperature.

DISSOLVED OXYGEN PROBE

PANEL THREE

EXPERIMENTS TO DO!

1. Pour 75 ml of distilled water in a 250 mL beaker. Put the dissolved oxygen (or DO) probe in it.

2. Take the dissolved oxygen probe out of the 250 mL beaker of distilled water. Place it in another 250 mL beaker of water and add seven ice cubes. Read the dissolved oxygen probe. Return the DO probe to the beaker of distilled water.

3. Pour 100 mL of heated water in a 250 mL beaker. Put the dissolved oxygen probe in it. Read the dissolved oxygen probe and then put it back in the distilled water.

4. Pour 250 mL of water in a 1000 mL beaker. With the DO probe take the oxygen reading of the water. Next, take the eggbeater and put it in the beaker of water. Beat the water with the eggbeater around in the water for three minutes. Take the DO probe and measure the level of oxygen in the beaker now. Is there an increase or decrease in the oxygen level?

5. Pour 250 mL of water in a 1000 mL beaker. Measure the DO using the probe. Now pour the water into another beaker and then back into the same beaker. Measure the DO of the water again. Did the oxygen level increase? Try it again.

Macroinvertebrates station
For each of the four groups that rotate through this station:
Go out to a nearby stream and take a sample of two 1000 ml beakers of the bottom soil in the stream in an area with a rubble or gravel bottom. The sample should be placed in a 70% alcohol preservative solution for later sorting.
1 18 1/2” x 11” tray with light colored bottom for each student
water to cover the tray about 1/2 inch deep
apron for each student
3 buckets for waste water
1 ruler for each student
12 petri dishes
1 strainer or net to transfer soil sample to tray
5 teaspoons

MACROINVERTEBRATES

PANEL ONE

The relationship between the composition of the aquatic community and water quality has been recognized. A commonly used method for evaluating water quality is by looking at macroinvertebrates, or large organisms that can be seen easily without a microscope and have no backbone or vertebra. The concept of indicator organisms is based on the fact that every species has a certain range of physical and chemical parameters in which it can survive. By charting numbers and kinds of organisms found you can determine if a stream is of good, fair, or poor quality.

The macroinvertebrates are easiest to identify using the Save the Stream keys. In identifying the animals use the body, shape, size, tail, number of legs, and color. Ask yourself the following questions to identify an organism:

*How large is the organism?
*Is the body long and slender, round, or curved?
*Does the organism have any tails? How many?
*Does the organism have any antennae?
*Does the organism have legs? How many?
*Does it have pinching jaws like a beetle larva?
*What color is the organism?

The pollution tolerance index is base on the concept of indicator organisms and tolerance levels.

*Group I: Stonefly, Caddisfly, Water Penny, Riffle Beetle, Mayfly, and Gilled Snail are found in good quality water.

*Group II: Crayfish, Sowbug, Scud, Fishfly larva, Damselfly, Watersnipe Fly, Crane Fly, Clam are found in fair quality water.

*Group III: Aquatic Worm, Midge Fly Larva, Blackfly Larva, Leech, and Pouch Snails indicate poor quality water.

MACROINVERTEBRATES

PANEL TWO

This identification key is available from the Izaak Walton League of America’s Save Our Streams Program, 707 Conservation Lane, Gaithersburg, Md 20878-2983, phone 301-548-0150

MACROINVERTEBRATES

PANEL THREE

EXPERIMENTS TO DO!

1. Put the apron on.

2. Take a handful of mud and put it on the tray. Add enough water to cover the mud about one -half inch.

3. Use a spoon and slowly separate the mud. Look for animals.

4. Use the charts in panel two to identify the macroinvertebrates. If the chart is not available then sketch the animal and try to identify it later.

5. To help compare specimens, place then in water in petri dishes containing similar organisms. This step provides a rough sorting of the organisms into major groups to aid in identification.

6. When you are finished pour the water and mud mixture into the waste bucket and get another handful of mud if time permits.

7. Before you change and go to the next group, wash your hands. Dump the mud and water into the waste bucket.

Instruct the class on how to get the CBL and TI 83 calculator ready for testing. At the base of the CBL are two ports. The left port is the communications port that connects the CBL to the calculator by the black TI 83 calculator link cable. Plug the probe you will be using into Channel 1 on the CBL. Turn the calculator on and then the CBL.

Follow these directions:
*Press “**PRGM**” button on TI for program selection.
*At “EXEC EDIT NEW” select < **1: Physics>** then press **ENTER**
*At “prgm PHYSICS” press **ENTER**
*At “VERNIER SOFTWARE” press **ENTER**
*”Main Menu”: select **<1: Set up Probes** > then press **ENTER**
*At Number of Probes: select **<1:one>** then press **ENTER**
*At Select Probe: select <**6: Temperature**> then press **ENTER**
*At Plug This Probe Into Channel 1: plug **in the sensor** then press **ENTER**
*Calibration: select **<1: Use Stored>** then press **ENTER**
*Main Menu: select **<2: Collect Data** > then press **ENTER**
*At Data Collection: select **<2: Time Graph>** then press **ENTER**
*At Enter Time Between Sample in Seconds: <**1.0**> then press **ENTER**
*At Enter Number of Samples: **<20.0>** then press **ENTER**
*Next screen: press **ENTER**
*Continue: select <**1: Time Setup**> then press **ENTER**
*At Time Graph: select **<2: Live Display**> then press **ENTER**
*At Set Y- axis:
Y min = **<0>** then press **ENTER**
Y max = **<50>** then press **ENTER**
Yscl = **<5>** then press **ENTER**
*Press ENTER to Begin Collecting Data: press **ENTER**
*When the CBL system indicates “**DONE**” press **ENTER**
Line graph will be displayed on the screen.
*To **Repeat** the experiment: select **<2 YES>** then press **ENTER**
*Repeat everything by going back to *At Set Y-axis for each time you measure temperature.

CLEAN WATER DETECTIVES

PROBLEM:

WHERE IT HAPPENED?

SITES ON MAP INVESTIGATED WITH FACTS COLLECTED:

CAUSE:

SOLUTION:

TECHNOLOGY INTEGRATION ASSESSMENT:

	Excellent	Good	Needs Improvement
Experiment Process	Steps are followed exactly during the actual experiment.	Most steps are followed during the experiment.	Steps frequently not followed during the experiment.
Experiment Notes	Data is accurate, neat, and well organized	Data is recorded accurately and is organized so that it is easy to interpret.	Data is not carefully recorded and /or is disorganized, messy or difficult to interpret.
Experiment Report-General	Data is analyzed and a written explanation of the data covers all-important facts that were learned.	Data is analyzed and the written explanation covers most of the facts that were learned.	Data is not analyzed in written form or does not explain the data that was obtained.
Experiment Report-Graphs	Graphs are appropriate with axis labeled with units, a clear title, and fully support the data	Graphs are appropriate with minor omissions but fully support the data	Graphs were difficult to interpret and did not support the report's data.
Experiment Report-Conclusions	Conclusions are based on analysis of data and fully answer the problem in detail.	Conclusions are based on an analysis of the data, but lack detail.	Conclusions not based on data, but an attempt was made to explain the experiment.
Experiment Report-Style	The word processor was used to write the report and computer graphics were used for graphs.	The word processor was used to write the report and an attempt was made to use graphs with minor deficiencies noted.	The word processor was used to write the report, and an attempt was made to use computer graphics with major deficiencies noted.